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STUDIES ON INDIAN PODOSTEMACEAE

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Podostemaceae are mostly small thalloid annuals, growing on rocks and stones in rapidly flowing waters. The reproductive phase of the plant appears much different from that of the vegetative phase. A perusal of literature makes it clear that there is considerable scope for taxonomic work on the Indian Podostemaceae. Gardner (1847) described the following from India : *Podostemon dichotomum, P. elongatum, P. griffithii, P. olivaceum, P. subulatus* and *Tristicha ceylanica.* Tulasne (1852) added description for one more, *Mniopsis hookeriana.* Wight (1852), in his Icones, included several Indian species, but the details on the size and shape of the parts illustrated are not accurate. Beddome (1865) described *Dicraea algaeformis* and *Mniopsis selaginoides,* from Anamalais. Weddell (1873) redefined the genus *Hydrobryum.* After discussing the systematic position of the family, Warming (1881, 1882, 1888, 1899, 1901) provided accurate figures for many taxa including a few Indian species. Willis (1902a) in his monograph provided a detailed, illustrated, first hand account on the genera, *Dicraea, Farmeria, Griffithella, Hydrobryum, Lawia, Podostemon, Tristicha* and *Willisia* collected from India and Sri Lanka (Ceylon). Willis (1902b, 1914a, 1914b), after a detailed study, considered the genera *Tristicha* (including *Indotristicha*), *Lawia* (= *Dalzellia*) and *Weddellina* in a separate family, Tristichaceae. But Engler (1930) divided the family into 3 sub-families, Weddellinoideae, Tristichoideae and Podostemoideae. Sprague (1933) pointed out that the family should be spelt PODOSTEMACEAE and not Podostemonaceae. Nandi (1937) in an account on the Podostemaceae of Khasi hills, described a new species, *Dicraea agharkarii.* Other noteworthy taxonomic accounts on the Indian species include that of Subramanyam (1962), Ramamurthy and Joseph (1964), Sastry and Joseph (1967), Subramanyam and Sreemadhavan (1969), Rao and Hajra (1970, 1979), Naithani (1971), Sharma *et al.* (1974), Nagendran *et al.* (1976) and Arekal and Nagendran (1974, 1977). In recent years, Brink (1969) and Hall (1971) discussed nomenclatural aspects of Indian genera. Most of the earlier descriptions of the plants, based on fragments, gathered during dry seasons, have also caused taxonomic confusion. For an accurate picture of these bizarre, polymorphic plants, one should visit their habitat during different seasons and make collections in a suitable liquid medium, for a detailed study in the laboratory. When two or more species grow in the same locality, as is often the case with the Indian species, there is the possibility of confusing one for the other. It has been possible to collect practically all the species from their type localities and observe several populations of one and the same species at different localities for the last seven (1971-1978) years. These collections are in The Herbarium, Postgraduate Department of Botany, University of Mysore, and based on these a paper on distribution has been published (Nagendran *et al.* 1976). The following twenty species of Podostemaceae are known to occur in India : *Cladopus hookeriana* (Tul.) Cusset, *Dalzellia zeylanica* (Gardn.) Wight, *Farmeria indica* Willis emend. Arekal & Nag., *Hydrobryopsis sessilis* (Willis) Engl., *Hydrobryum griffithii* (Wall. ex Griff.) Tul., *Indotristicha ramosissima* (Wight) van Royen, *I. tirunelveliana* Sharma, Karthik. & Shetty, *Podostemum barberi* Willis (?) *P. subulatus* Gardn., *Polypleurum agharkarii* (Nandi) Nag. Arekal & Subr., *P. dichotomum* (Gardn.) Hall, *P. filifolium* (Ram. & Joseph) Nag., Arekal & Subr., *P. minor* (Weddell) Nag., Arekal & Subr., *P. munnarense* Nag. & Arekal, *P. stylosum* (Wight) Hall, *P. wallichii* (R. Br. ex Griff.) Warming, *Willisia selaginoides* (Bedd.) Warming ex Willis, *Zeylanidium johnsonii* (Wight) Engl., *Z. lichenoides* (Kurz) Engl., *Z. olivaceum* (Gardn.) Engl.

KEY TO THE INDIAN GENERA OF PODOSTEMACEAE

1a. Flowers trimerous; pollen in monads.

2a. Secondary shoots branched, more than 15 cm long ... 1. *Indotristicha*

2b. Secondary shoots unbranched, less than 2 cm long ... 2. *Dalzellia*

1b. Flowers not trimerous; pollen in dyads.

3a. Fruits 8-14-seeded ... 3. *Farmeria*

3b. Fruits more than 30-seeded.

4a. Capsules smooth.

5a. Flowering shoots more than 4 cm long, erect ... 4. *Willisia*

5b. Flowering shoots less than 1 cm long, sessile.

6a. Fruits nearly sessile ... 5. *Hydrobryopsis*

6b. Fruits distinctly stalked ... 6. *Cladopus*

4b. Capsules ribbed.

7a. Thallus entirely appressed to rocks.

8a. Fruits isolobous, 12-ribbed ... 7. *Hydrobryum*

8b. Fruits anisolobous, 8-ribbed ... 8. *Zeylanidium*

7b. Thallus partly appressed to rocks.

9a. Flowering bracts present; fruits isolobous ... 9. *Polypleurum*

9b. Flowering bracts absent; fruits anisolobous .. 10. *Podostemum*

INDOTRISTICHA van Royen

1. **Indotristicha ramosissima** (Wight) van Royen in Acta Bot. Neerl. 8 : 474. 1959. *Dalzellia ramosissima* Wight, Ic. Pl. 5 : 35. 1852. *Terniola ramosissima* (Wight) Weddell in DC. Prodr. 17 : 47. 1873. *Tristicha ramosissima* (Wight) Willis in Ann. Roy. Bot. Gard. Perad. 1 : 208. 1902.

Thread-like thallus attached to rocks by disc-like feet with many free floating frequently branched secondary shoots which are up to 30 cm long.

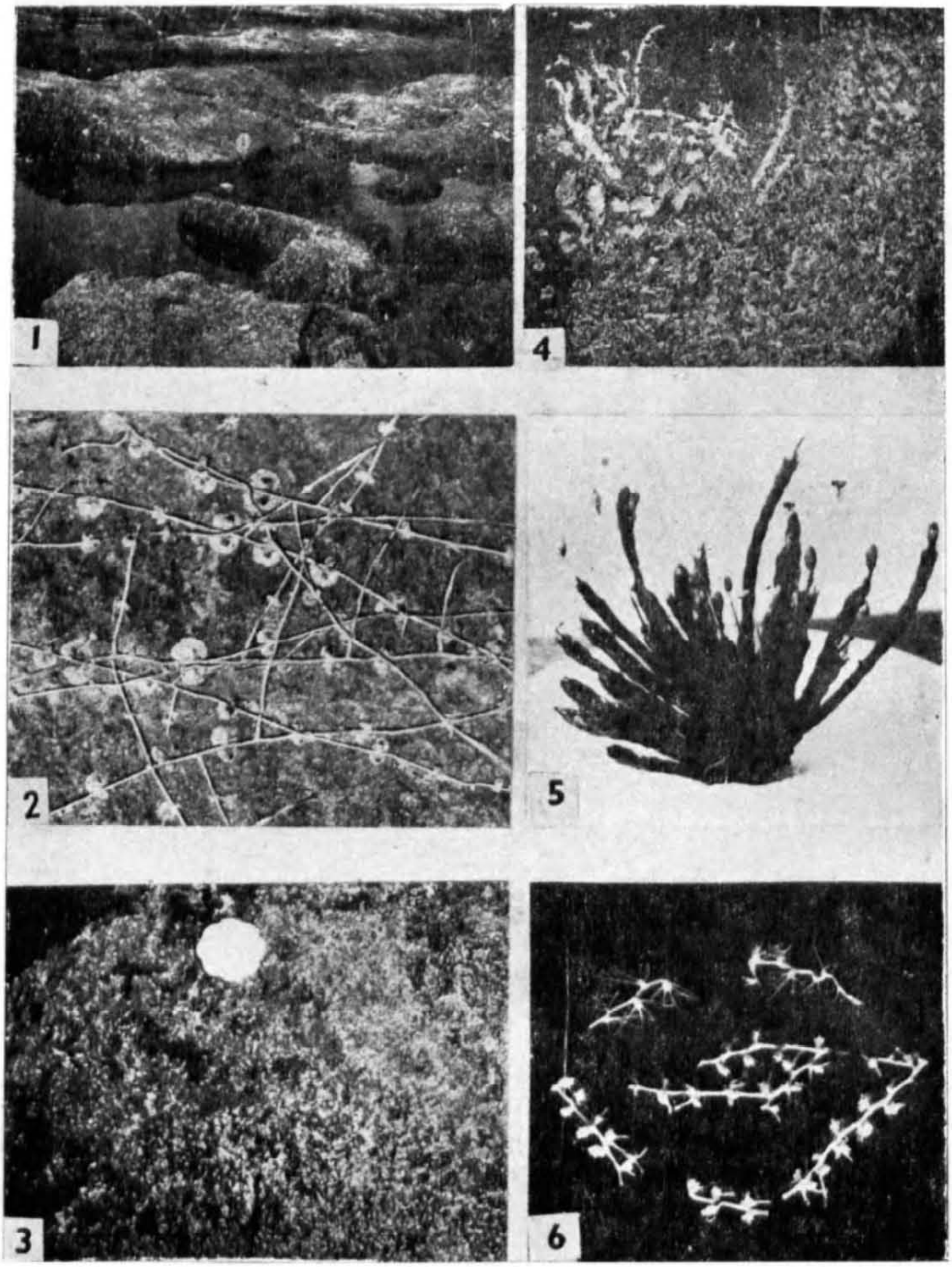
Distribution : Western ghats of Karnataka, Kerala and Tamil Nadu.

DALZELLIA Hassk.

2. **Dalzellia zeylanica** (Gardn.) Wight, Ic. Pl. 5 : 34. 1919-1920. 1852; Brink in Taxon 18 : 598. 1969. *Tristicha zeylanica* Gardn. in Calc. Journ. Nat. Hist. 7 : 177. 1847. *Lawia zeylanica* Tul. Ann. Sci. Nat. Ser. III. 2 : 112. 1849 emend. Willis in Ann. Roy. Bot. Gard. Perad. 1 : 213. 1902. *Terniola zeylanica* (Gardn.) Tul. Arch. Mus. Hist. Nat. Paris 6 : 190. t. 13. f. 3. 1852.

Crimson red thallus closely appressed to rock boulders, often difficult to separate from rocks.

Distribution : Western ghats of Karnataka, Kerala and Tamil Nadu.



Figs. 1-6. 1. *Indotristicha ramosissima* and *Polypleurum stylosum* at habitat. 2. Prostrate branches of *I. ramosissima* showing paired discs. 3. Thallus of *Dalzellia zeylanica* at habitat. 4. Prostrate type of thalli of *Cladopus hookeriana* at fruiting phase. 5. Erect secondary shoots of *Willisea selaginoides* with fruits. 6. Vegetative and flowering thalli of *Farmeria indica.*

CLADOPUS Muell.

3. **Cladopus hookeriana** (Tul.) Cusset, Flora du Cambodge, L's Vietnam 14 : 72. 1973. *Mniopsis hookeriana* Tul. in Ann. Sci. Nat. Ser. III. 2 : 105. 1849. *Podostemon hookerianus* (Tul.) Weddell in DC. Prodr. 17 : 74. 1873. *Griffithella hookeriana.* (Tul.) Warming, Kgl. Danske Vid. Selsk. Ski. VI, 2 : 13. 1901.

Thallus star-like, cup-like or ribbon-like; brick red when young; partially attached and green when old. Secondary shoots many, on the margins.

Distribution. : Endemic to the Western Ghats of Karnataka and Maharashtra.

WILLISIA Warming

4. **Willisia selaginoides** (Bedd.) Warming ex Willis in Ann. Roy. Bot. Gard. Perad. 1 : 370. 1902. *Mniopsis selaginoides* Bedd. in Madras Journ. Sc. Ser. III. 54. 1864. *Podostemon selaginoides* Benth. in Benth. & Hooker, Gen. Pl. 3 : 113. 1880.

Stiff secondary shoots forming tufts more prominent than the thallus.

Distribution : Endemic to Western Ghats of Kerala and Tamil Nadu.

FARMERIA Willis

5. **Farmeria indica** Willis in Notes to Trimen's Fl. Ceylon 5 : 386. 1900 & Ann. Roy. Bot. Gard. Perad. 1 : 248. 1902; emend. Arekal & Nag., in Proc. Indian Acad. Sci. B 80 : 226. 1974.

Thallus like entangled threads; very rare.

Distribution : Endemic to Tirunelveli, Tamil Nadu (Type locality).

ZEYLANIDIUM (Tul.) Engler

Zeylanidium johnsonii (Wight) Engl. in Engl. & Prantl, Nat. Pflanzenfam. 18a : 62. 1930. *Mniopsis johnsonii* Wight, Ic. Pl. t. 1919. f. 5. 1852. *Podostemon johnsonii* (Wight) Weddell in DC. Prodr. 17 : 75. 1873. *Hydrobryum johnsonii* (Wight) Willis in Ann. Roy. Bot. Gard. Perad. 1 : 241. 1902.

Secondary shoots many and scattered on the crustaceous thallus.

Distribution : Karnataka, Kerala and Andhra Pradesh.

7. **Z. lichenoides** (Kurz) Engl. in Engl. & Prantl, Nat. Pflanzenfam. 18a : 62. 1930. *Hydrobryum lichenoides* Kurz in Journ. Asiat. Soc. Bengal 42 : 103. 1873. *Podostemon microcarpus* Weddell in DC. Prodr. 17 : 76. 1873.

Thallus pinnately branched, sometimes more or less confluent into a crustaceous unit. Branches acropetal, alternate. Secondary shoots many in axils and on sides of thallus lobes.

Distribution : Very common in South West and North East India. It is recorded from Maharashtra, Karnataka, Andhra Pradesh and Assam.

8. **Z. olivaceum** (Gardn.) Engl. in Engl. & Prantl. Nat. Pflanzenfam. 18a : 62. f. 55 A-K. 1930. *Podostemon olivaceum* Gardn. in Calc. Journ. Nat. Hist. 7 : 181. 1847. *Hydrobryum olivaceum* (Gardn.) Tul. in Ann. Sci. Nat. Ser. III, 2 : 104. 1849.

Thallus thin, green, irregularly lobed, up to 10 cm in diameter. Secondary shoots small, many, in all directions.

Distribution : Kerala, Tamil Nadu and Arunachal Pradesh.

HYDROBRYUM Endlicher

9. **Hydrobryum griffithii** (Wall. ex Griff.) Tul. in Ann. Sc. Nat. Ser. III. 11 : 103. 1849 & Arch. Mus. Hist. Nat. 6 : 141. 1852. *Podostemon griffithii* Wall. ex Griff. Asiat. Res. 19 : 105. t. 17. 1836.

Thallus crustaceous, more or less circular in form, twisted variously in all directions. Secondary shoots many, irregularly scattered only on the dorsal surface.

Distribution : Assam, Uttar Pradesh, Manipur and Sikkim (Naithani, 1971).

POLYPLEURUM (Tayl. ex Tul.) Warming

In India, there are seven species. Because of material scarcity, only South Indian species are cited here :

10. **Polypleurum dichotomum** (Gardn.) Hall in Kew Bull. 26 : 131. 1971. *Podostemon dichotomum* Gardn. in Calc. Journ. Nat. Hist. 7 : 185. 1847. *Dicraea dichotoma* Tul. in Ann. Sc. Nat. Ser. III 2 : 101. 1849.

Thallus flat, long, up to 30 cm, sparingly branched, basal portion attached to rocks; upper usually free floating, often zigzag. Secondary shoots distichous, on all parts of thallus, about 2-3 mm apart; non-floriferous parts of thallus deciduous on exposure. Flowers not crowded.

Distribution : Maharashtra and Tamil Nadu.

11. **P. filifolium** (Ram. & Joseph) Nag. & Arekal & Subr. in Pl. Syst. Evol. 128 : 215. 1977. *Dicraea filifolia* Ram. & Joseph in Bull. Bot. Surv. Ind. 6 : 333. 1964.

Thallus membranous, completely appressed to rocks. Secondary shoots numerous, slender, filiform, up to 20 mm long. Leaves in 3 pairs, lower 2 pairs with one long filament and the uppermost pair with 2 filaments each.

Distribution : Kerala and Orissa.

12. **P. munnarense** Nag. & Arekal in Bot. Notiser 132 : 49. 1979.

Leaf tips persist during flowering.

Distribution : Munnar, Idukki District, Kerala (Type locality).

13. **P. stylosum** (Wight) Hall in Kew Bull. 26 : 131. 1971. *Dicraea stylosa* Wight, Ic. Pl. t. 1917. f. 2. 1852. *Polypleurum stylosus* Hook. f. in Fl. Brit. Ind. 5 : 64. 1886.

Thallus fleshy, to 6 cm or more in length, with a basal foot and spreading in all directions. Secondary shoots many, marginal, non-floriferous parts deciduous. In our collections there are two distinct varieties : one tallies with Fig. 4A of Engler (1930) and the other to *Dicraea stylosa* var. *kanarensis* of Willis (1902a). Whether they should be treated as two different varieties or species is under consideration.

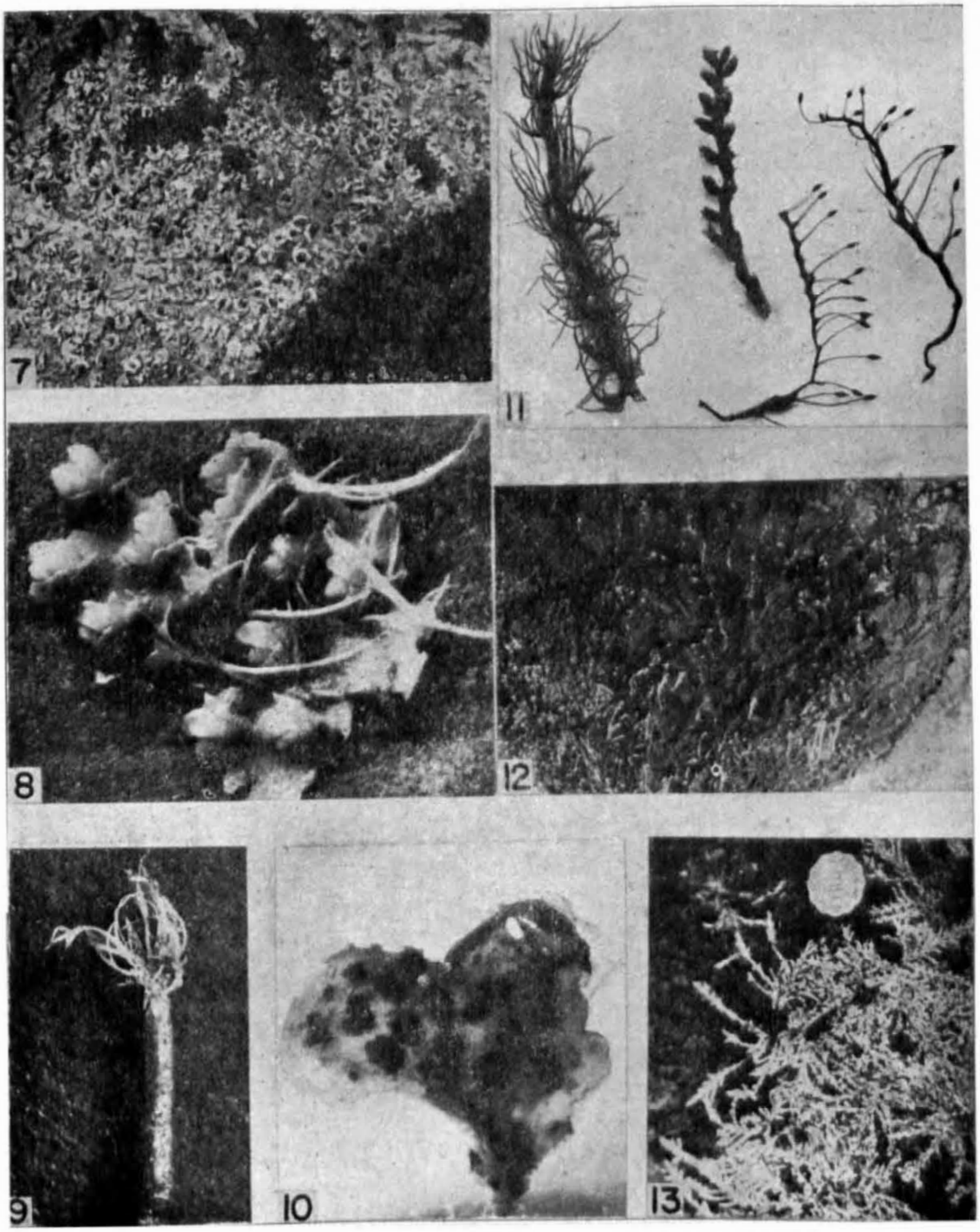
Distribution : Maharashtra, Kerala, Tamil Nadu, Meghalaya and Assam.

HYDROBRYOPSIS Engler

14. **Hydrobryopsis sessilis** (Willis) Engl. in Engl. & Prantl, Nat. Pflanzenfam. 18a : 60. f. 53A-C. 1930. *Hydrobryum sessile* Willis in Ann. Roy. Bot. Gard. Perad. 1 : 239. 1902a.

Thallus small, pinnately branched like a fern leaf, closely appressed to rocks, sometimes more or less confluent into a crustaceous disc Secondary shoots marginal, many, along sides of branches, each shoot with 5 to 8 linear leaves.

Distribution : Endemic to the Western ghats of Karnataka and Maharashtra.



Figs 7-13 7 Fruiting stage of *Zeylanidium lichenoides* at habitat. 8. Portion of thallus of *Z. olivaceum* showing many secondary shoots. 9. Primary axis of *Z. olivaceum* with a brush of leaves. 10. Part of thallus of *Hydrobryum griffithii* with many secondary shoots. 11-13. Portions of fruiting flowering and vegetative thalli of *Polypleurum dichotomum*.

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*Not seen original.